THE CO-OPERATIVE UNIVERSITY OF KENYA

DEPARTMENT OF COMPUTER SCIENCE AND IT

BACHELOR OF SCIENCE IN COMPUTER SCIENCE – YEAR - IV SEM - 1 & BSIT > YEAR – IV SEM. – I

SEPTEMBER – DECEMBER, 2024

COURSE CODE: BCSC 4126 **COURSE TITLE:** SIMULATION AND MODELING

(As scheduled on timetable - TUESDAYS, 1:00PM – 4:00PM – VENUE- COMP. LAB 2

Course Unit Lecturer: Silas K. Maiyo Tel: +254(0)723479177 **E-mail:** smaiyo@cuk.ac.ke

COURSE OUTLINE

1. PRE-REQUISITES:

BCIT 2212 - Software Engineering

2. COURSE UNIT PURPOSE

This course teaches the effective ways of developing and simulating computer system models for solving scientific problems.

2.0 EXPECTED LEARNING OUTCOMES

By the end of this course unit, the learner should be able to:

i. Understand fundamental concepts of computer simulation and its role in engineering problem solving.
ii. Explain a variety of simulation models.
iii. Explain the advantages of using simulation and modelling for taking decision in engineering problems.
iv. Describe simulation system principles and relate them to real life application
v. Construct a model for a given set of data and motivate its validity.

3.0 COURSE CONTENT

Introduction to modelling and simulation. The basic concepts of computation through modeling and simulation to shorten design cycles, and innovate new products System analysis, classification of systems. System theory basics, its relation to simulation. Model classification: conceptual, abstract, and simulation models. Heterogeneous models. Methodology of model building. Simulation systems and languages, means for model and experiment description. Principles of simulation system design. Parallel process modelling. Using Petri nets and finite automata in simulation. Models of queuing systems. Discrete simulation models. Model time, simulation experiment control. Continuous systems modelling. Overview of numerical methods used for continuous simulation. System Dymola/Modelica. Combined simulation. The role of simulation in digital systems design. Special model classes, models of heterogeneous systems. Cellular automata and simulation. Checking model validity, verification of models. Analysis of simulation results. Simulation results visualization. Model optimization. Generating, transformation, and testing of pseudorandom numbers. Stochastic models, Monte Carlo method. Overview of commonly used simulation systems.

4.0 LECTURE SCHEDULE (42 HRS)

WEEK	TOPIC	HOURS	CONTENT
1	**1**	2hrs	**Topic**: Introduction to Simulation and Modeling - The basic concepts of computation through modeling and simulation to shorten design cycles, and innovate new products: Terminology – System, Modeling, Simulation, discrete event modeling; time slicing; complexity; variability; verification, validation; Monte Carlo simulation.

WEEK	TOPIC	HOURS	CONTENT
			- System analysis, classification of systems. System theory basics, its relation to simulation
2	**2**	4hrs	**Topic**: Model Classification - Conceptual, abstract, and simulation models. Heterogeneous models. Methodology of model building. - Simulation software examples - Simulation systems and languages, means for model and experiment description.
3	**3**	4hrs	**Topic:** PRINCIPLES OF SIMULATION SYSTEM DESIGN - Parallel process modelling. Using Petri nets and finite automata in simulation. - Models of queuing systems. Discrete simulation models. Model time, simulation experiment control. Continuous systems modelling.
4	**4**	4hrs	**Topic:** OVERVIEW OF NUMERICAL METHODS USED FOR CONTINUOUS SIMULATION. - System Dymola / Modelica. Combined simulation. - MatLab, Simulink
5	**5**	2hrs	Continuous Assessment Tests (CATS)
6	**6**	4hrs	**Topic:** THE ROLE OF SIMULATION IN DIGITAL SYSTEMS DESIGN. - Special model classes, models of heterogeneous systems. - Cellular automata and simulation. Checking model validity, verification of models.
7	**7**	4hrs	**Topic:** ANALYSIS OF SIMULATION RESULTS. - Simulation results visualization.
8	**8**	2hrs	Continuous Assessment Tests (CATS)
9	**9**	4hrs	**Topic:** MODEL OPTIMIZATION. - Generating, transformation, and testing of pseudorandom numbers. Stochastic models, Monte Carlo method
10	**10**	2hrs	**Topic:** LAB SESSIONS – SIMULATION AND MODELING – OPTIMIZATION & TESTING
11	**11**	4hrs	**Topic:** OVERVIEW OF COMMONLY USED SIMULATION SYSTEMS.
12	**12**	4hrs	Course Review - Previous examinations review - Submission of assignments
12-13		2hrs	Final end-of-semester examinations

5.0 COURSE EVALUATION

The course will be evaluated through Continuous Assessment Tests (CATs) and final semester examinations. The CATs will account for 30 marks while the final examination will be worth 70 marks. There will be 2 CATs, the first of which will be done in Week 5 and the second in Week 8. Each CAT will be worth 20 marks, also assignments and online quizzes will be done each worth 20 marks. The scores will be graded as follows:

i.	Continuous Assessment Tests	30%
iii.	End of session examination	70%
Total		**100%**

The pass mark is 40%

Any student found in examination irregularities (whether CATs, Assignment and final exam) will be subjected to hash CUK disciplinary process

6.0 MODE OF DELIVERY

- This is course is blended (both in-person and online) that will primarily be delivered through the internet with electronic communities and administrative centres for both students and faculty interactions. Students are advised not to be late in joining online virtual classrooms as no more entry will be allowed after start of class/lecture. Meeting link will be posted on Learning Management system (LMS) URL: emasomo.cuk.ac.ke
- Lectures, discovery learning, problem based learning, experiential learning, group based learning, independent studies and eLearning tutorials

7.0 INSTRUCTIONAL MATERIALS AND EQUIPMENT

- The course has a lot of interactive online learning objects developed by the Course unit Lecturer and case studies from internet materials e.g. power point presentations, PDF handout notes, online videos and other interactive lab practical, games and other resources.
- Whiteboards, markers, hand-outs, presentation software, LCD projectors and computers, Flipcharts, and videos will form part of primary instructional materials and equipment
- Resources will be uploaded on eMasomo.cuk.ac.ke for access including download by students.
- Development Platforms / Software e.g. Simulators & Modelers:
  - ***Standard:*** Arena, Dymola / Modelica, Octave / MATLAB, Simulink etc.
  - ***Alternative:*** Ruby, C++, Java, Python, Perl, Prolog etc

8.0 REFERENCES

Course textbooks

1. Fishwick, P. (1995). Simulation Model Design and Execution. Prentice-Hall, ISBN 0-13-098609-7
2. Law, A., & Kelton, D. (1991). Simulation Modelling and Analysis. McGraw-Hill, ISBN 0-07-100803-9
3. Paul, A. (1995).Simulation Model Design and Execution: Building Digital Worlds, Prentice Hall. ISBN: 0130986097.

Reference Textbooks

1. Klee, H. (2007). Simulation of Dynamic Systems with Matlab and Simulink. CRC Press Inc, Taylor & Francis Group: Boca Raton London New York. ISBN 1420044184 (pb)
2. Sheldon, R.M. (2006). Simulation .Elsevier: Amsterdam, ISBN 0125980639.
3. Malvino, A. (2007). Electronic Principles and Simulation (7th edition),ISBN 0070634246

Course Journals

1. Elsevier Simulation Modelling Practice and Theory Journal. ISSN 1569-190X.
2. ACM Transactions on Modeling and Computer Simulation. ISSN: 1049-3301.
3. Journal of Statistical Computation and Simulation. ISSN: 0094-9655.

Reference Journals

1. Sage Simulation Journal. ISSN: 00375497.
2. Palgrave Journal of Simulation. ISSN: 1747-7786.
3. International Journal of Simulation Modelling. ISSN: 1726-4529.

9.0 LECTURER CONTACT

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